REMARKS

The Office Action dated November 4, 2009, has been received and carefully considered. In this response, claims 1, 3, 56, 58, 69, 113, 115, 143, 154, 157, 159, 160, 162-165, 167, 168, 170, 198, 212, 214,216, 217, 219-221, 223-225, 227, 255, 256, 266, 268, 269, 271, 272, 274-277, 279, 280, 282, 310, 324, 326, 328, 329, 331-333, 335, and 336 have been amended, and claims 2, 57, 114, 169, 226, and 281 have been cancelled without prejudice. No new matter has been added. Entry of the amendments to claims 1, 3, 56, 58, 69, 113, 115, 143, 154, 157, 159, 160, 162-165, 167, 168, 170, 198, 212, 214,216, 217, 219-221, 223-225, 227, 255, 256, 266, 268, 269, 271, 272, 274-277, 279, 280, 282, 310, 324, 326, 328, 329, 331-333, 335, and 336, and the cancellation of claims 2, 57, 114, 169, 226, and 281 without prejudice is respectfully requested. Reconsideration of the current objections/rejections in the present application is also respectfully requested based on the following remarks.[1]

[1] As Applicants' remarks with respect to the Examiner's rejections are sufficient to overcome these rejections, Applicants' silence as to assertions made by the Examiner in the Office Action or certain requirements that may be applicable to such rejections (e.g., assertions regarding dependent claims, whether a reference constitutes prior art, whether references are legally combinable for obviousness purposes) is not a concession by Applicants that such assertions are accurate or such requirements have been met, and Applicants reserve the right to analyze and dispute such in the future.

I. THE EXAMINER INTERVIEW

At the outset, the Applicants thank the Examiner for the courtesies extended during the interview conducted on January 4, 2010, during which the claims were discussed.

II. THE INFORMATION DISCLOSURE STATEMENT

In the prior Office Action, the Examiner asserts that the Information Disclosure Statement and accompanying PTO-1449 form that were filed on December 6, 2006, do not comply with 37 CFR § 1.98(b). The Examiner asserts that three references (citation numbers 28, 56, and 60) do not have the proper publication date. The Examiner appears to have considered the three references by initialing same in the PTO-1449 form. Thus, it appears that the Examiner is requesting that Applicants provide the full publication dates for the three references. Applicants hereby provide this information as follows:

28.) T. Q. Nguyen, "A tutorial on filter banks and wavelets," University of Wisconsin, Madison, WI53706, USA, published in *Proc. IEEE International Conference on Digital Signal Processing,* Cypress, June 1995.

56.) "Digital compression and coding of continuous-tone still images," Int. Org. Standardization ISO/IEC, JTC1 Committee Draft, JPEG 8-R8, August 1990.

60.) N. D. Memon et al., "Lossless image compression: A comparative study," *Proc. SPIE*, Vol. 2418, pp. 8-20, March 1995.

In view of the foregoing, Applicants respectfully request that the Examiner confirm that these three references have been considered and formally withdraw the aforementioned objection to the Information Disclosure Statement.

III. <u>THE INDEFINITENESS REJECTION OF CLAIMS 1-336, 449, AND 450</u>

On page 2 of the Office Action, claims 1-336, 449, and 450 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the invention. This rejection is hereby respectfully traversed.

The Examiner asserts that the term "the specified contexts" in claim 1 is indefinite. Applicants respectfully disagree. Also, the Examiner is incorrect in interpreting the term "specified contexts" as "transformed coefficients." The term "specified contexts" is described in the specification and drawings (e.g., Figure 32; page 31, line 5) as magnitude context *MC* for magnitudes of transformation coefficients, and also in the specification and drawings (e.g., Figure 33; page 32, line 4) as ternary context *TC* for signs of transformation coefficients. The term "specified contexts" is used elsewhere in the specification (e.g., page 11, line 28; page 11, line 32; page 12, line 1; page 18, line 12; page 19, line 17; page 20, line 11; and page 20, line 28), and does not describe "magnitude

and/or ternary contexts of transformation coefficients".

However, in order to forward the present application toward allowance, Applicants have amended all claims 1, 3, 56, 58, 113, 115, 143, 154, 157, 159, 160, 162, 163, 164, 165, 167, 168, 170, 198, 212, 214, 216, 217, 219, 220, 221, 223, 224, 225, 227, 255, 266, 269, 271, 272, 274, 275, 276, 277, 279, 280, 282, 310, 324, 326, 328, 329, 331, 332, 333, 335 and 336, using term "contexts of transformed coefficients" instead of "specified contexts".

In view of the foregoing, Applicants respectfully request that the aforementioned indefiniteness rejection of claims 1-336, 449, and 450 be withdrawn.

IV. THE OBVIOUSNESS REJECTION OF CLAIMS 1-13, 31, 34, 56-68, 86-89, 113-125, 143-146, 168-180, 198-201, 225-237, 255-258, 280-292, 310-313, 449, AND 450

On pages 3-17 of the Office Action, claims 1-13, 31, 34, 56-68, 86-89, 113-125, 143-146, 168-180, 198-201, 225-237, 255-258, 280-292, 310-313, 449, AND 450 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,141,446 to Boliek et al. ("Boliek") in view of U.S. Patent No. 5,926,791 to Ogata et al. ("Ogata"). This rejection is hereby respectfully traversed.

Under 35 U.S.C. § 103, the Patent Office bears the burden of establishing a prima facie case of obviousness. In re Fine, 837 F.2d 1071, 1074 (Fed. Cir. 1988). There are four separate

factual inquiries to consider in making an obviousness determination: (1) the scope and content of the prior art; (2) the level of ordinary skill in the field of the invention; (3) the differences between the claimed invention and the prior art; and (4) the existence of any objective evidence, or "secondary considerations," of non-obviousness. Graham v. John Deere Co., 383 U.S. 1, 17-18 (1966); see also KSR Int'l Co. v. Teleflex Inc., 127 S. Ct. 1727 (2007). An "expansive and flexible approach" should be applied when determining obviousness based on a combination of prior art references. KSR, 127 S. Ct. at 1739. However, a claimed invention combining multiple known elements is not rendered obvious simply because each element was known independently in the prior art. Id. at 1741. Rather, there must still be some "reason that would have prompted" a person of ordinary skill in the art to combine the elements in the specific way that he or she did. Id.; In re Icon Health & Fitness, Inc., 496 F.3d 1374, 1380 (Fed. Cir. 2007). Also, modification of a prior art reference may be obvious only if there exists a reason that would have prompted a person of ordinary skill to make the change. KSR, 127 S. Ct. at 1740-41.

Regarding encoder claims 1-3 (apparatus), 113-115 (method) and 225-227 (article), the Examiner asserts that the claimed invention would have been obvious in view of Boliek and Ogata. Applicants respectfully disagree. Specifically, Applicants

respectfully submit that the Examiner has misunderstood the purpose of delay unit 15 in Ogata Figure 4, according to page 9 of the Office Action: "(as discussed in claims 1, 113, and 225, the delay unit of Ogata, Figure 4, numeral 15, is the synchronization memory to produce synchronized compressed data)", and "(as discussed in claims 1, 113, and 225, the delay unit of Ogata, Figure 4, numeral 15, is the compressed buffer for receiving and buffering synchronized data before output to next processing)". Applicants emphasize in this response that the wrong prior art Figure 5 appropriate to state-of-the-art, such as Ogata, was published in US20060053004A1, instead of correct Figure 13, which might have led the Examiner to the wrong conclusion.

Applicants would like to draw to the attention of Examiner that data after high-pass filter 11_H and downsampling 12_H of Ogata, Figure 4, are just high-pass filtered and downsampled, and not compressed. According to page 7 of the Office Action, copied from column 6, lines 31-39, of Ogata: "The delay unit 15 has a pre-set delay time equal to the signal processing time required in the analysis LPF 13_L and the downsampling unit 14_L and, for synchronizing the high frequency band signal $XH_0[j]$ from the first downsampling unit 12_H with the low frequency band signal $XL_1[k]$ and the high frequency band signal $XH_1[k]$ from the second stage downsampling units 14_L, 14_H, delays the high

frequency band signal $XH_0[j]$ for a pre-set time and sends the delayed signal to the quantizer 16c."

Applicants also would like to draw to the attention of the Examiner that the compression in Ogata is performed in the reversible encoder/multiplexer 17 of Ogata, Figure 4, AFTER the synchronization delay unit 15 and AFTER the quantization of transformation coefficients in quantizer 16c of Ogata, Figure 4. According to column 6, lines 53-60: "The reversible encoding/multiplexing unit 17 has a reversible encoding unit, such as an encoder unit for Huffman encoding, run-length encoding or arithmetic encoding, and variable-length encodes the signals $XL_1'[k]$, $KH_1'[k]$ and $XH_0'[j]$ supplied from the quantizers 16a, 16b and 16c, while multiplexing the variable length encoded signals, for sending the resulting signals as the encoded signals to a recording medium or over a transmission route, not shown."

Ogata, Figure 2, depicts art prior to Ogata, while Ogata Figures 4 and 6 show art disclosed in Ogata, according to Ogata column 5, lines 15-27. However, in either one of Ogata Figures 2, 4 or 6, the position of synchronization (delay) memory (numeral 125 in Ogata, Figure 2, numeral 15 in Ogata, Figure 4, and numerals 55a, 55b, 55c in Ogata, Figure 6) is the same, being between downsampling unit (numeral 122_H in Ogata, Figure 2, numeral 12_H in Ogata, Figure 4, and numerals 46_H, 47_L, 47_H in

Ogata, Figure 6) and quantizer (numeral 126c in Ogata, Figure 2, numeral 16c in Ogata, Figure 4, and numerals 56e, 56f and 56g in Ogata, Figure 6). This is EXACTLY THE SAME as the position of synchronization memory in well-known prior art encoder designs (numerals 120-122 in Figure 5, numerals 220-228 in Figure 7), being between single-level direct subband transformers (numerals 100-101 in Figure 5, and numerals 200-201 in Figure 7) and quantizers (numerals 140-141 in Figure 5, and numerals 240-245 in Figure 7).

Boliek, Figure 2, depicts additional elements which are not present in Ogata, Figure 2, such as multi-component handling 211, style select 210 and embedded binary style coding 204. These elements are not present in encoder claims 1-3 (apparatus), 113-115 (method) and 225-227 (article), so they will be neglected from the following analysis.

The Examiner on page 6 of the Office Action correctly concluded that Boliek does not explicitly disclose the data buffer to synchronize data, but is completely aware about the delay: "[i]n fact, there is a maximum delay between encoding and the production of a compressed output bit" at column 30, line 31. Besides this delay, Boliek requires huge memory for storage of all transformation coefficients as in specification Figures 5 and 7, due to:

1) parent-child context dependent relationship, disclosed

in Boliek, Figure 1, and Boliek, from column 17, line 55, to column 18, line 7, which require that ALL transformation coefficients from all wavelet decomposition levels MUST BE available at the same time in the memory BEFORE generating contexts, because relationships between transformation coefficients from all wavelet decomposition levels must be generated starting from the first to the last decomposition level (usually 3 to 7 levels, depending on image resolution);

2) the utilization of "bit-planes" as important level planes of the transformation coefficients and context model conditions wavelet coefficients in bit-significance representations, disclosed in Boliek, Figures 39 and 40; column 10, lines 19-23; and from column 20, line 63, to column 21, line 5, which require that ALL transformation coefficients MUST BE available at the same time in the memory BEFORE generating bit-plane contexts, because ALL bits at the same binary position (selected between most significant bit and least significant bit) from ALL transformation coefficients must be extracted in order to generate a bit-plane for that binary position, thus providing total of 24 separate bit planes for 24-bit long transformation coefficients, for example; and

3) entropy encoding after the histogram is generated, since "based on the histogram, the style is chosen", as disclosed in Boliek, column 12, lines 2-8, which means that ALL

transformation coefficients MUST BE available at the same time in the memory BEFORE start of the encoding, because histograms of transformation coefficients must be calculated first, then a style must be chosen and finally entropy encoding of the same transformation coefficients will be performed.

It is obvious from the aforementioned facts that reversible wavelet transform, embedded order quantization, context modeling and entropy coding in Boliek require huge synchronization memory producing delay, which is also confirmed by related U.S. Patent Nos. 5,966,465 (claims 1, 15, 16, 28, 33, 38, 39, 40 and 43), 5,867,602 (claims 31, 36 and 40) and 5,748,786 (claims 1, 9 and 17), which all resulted from a continuation-in-part process started from the same basic patent application Ser. No. 08/310,146. More specifically, Boliek (U.S. Pat. No. 6,141,446) is a continuation-in-part of application Ser. No. 08/643,268, entitled "Compression/Decompression Using Reversible Embedded Wavelets", filed May 3, 1996, now U.S. Pat. No. 5,966,465, which is a continuation-in-part of application Ser. No. 08/498,036, entitled "Reversible Wavelet Transform and Embedded Codestream Manipulation", filed Jun. 30, 1995, now U.S. Pat. No. 5,867,602, which is a continuation-in-part of application Ser. No. 08/310,146, entitled "Apparatus for Compression Using Reversible Embedded Wavelets", filed Sep. 1, 1994, now U.S. Pat. No. 5,748,786.

In amended encoding claims 1 (apparatus), 113 (method) and 225 (article), new lossless and lossy encoder are disclosed, appropriate to the specification Figures 13 and 15, by utilizing either state-of-the-art or new (disclosed later in the other claims) elements, such as: a single-level direct subband transformer, processing means (pass-through means as in claim 1 as filed or quantizer means as in claim 2 as filed), an encoding probability estimator, an entropy encoder and an output compressed buffer, connected AFTER the entropy encoder, without any additional synchronization (delay) memory used in Ogata, Figures 2, 4 and 6, being between the single-level direct subband transformer and the quantizer.

The amended apparatus claim 1 for both lossless and lossy compression, appropriate to the specification Figures 13 and 15, with underlined differences between the claimed invention and Boliek and Ogata is:

1. A fast encoder for compressing input data into output compressed data, comprising:

at least one single-level direct subband transformer, for receiving and transforming input data to produce transformation coefficients;

at least one processing means selected from a group **consisting of**: pass-through means for lossless processing and

quantizer means for lossy processing, coupled to at least one of said at least one <u>single-level direct subband transformer</u>, for receiving and processing the transformation coefficients to produce processed transformation coefficients;

at least one encoding probability estimator coupled to at least one of said at least one processing means, for receiving the processed transformation coefficients and estimating probabilities of symbols within contexts of transformation coefficients to produce the probabilities of symbols within the contexts of transformation coefficients;

at least one entropy encoder coupled to at least one of said at least one encoding probability estimator, for receiving and entropy encoding the processed transformation coefficients using the probabilities of symbols within the contexts of transformation coefficients to produce encoded data; and

an output compressed buffer coupled to at least one of said at least one entropy encoder, for receiving and <u>substantially synchronizing</u> the encoded data <u>with said fast encoder</u> to produce output compressed data.

For example, the prior art apparatus claim **E** for both lossless and lossy compression, appropriate to the combination of Boliek Figure 2 and Ogata Figures 2, 4 and 6, with underlined differences between THE CLAIMED INVENTION and Boliek and Ogata

is:

E. An encoder for compressing input data into output compressed data, comprising:

at least one single-level direct subband transformer, for receiving and transforming input data to produce transformation coefficients;

at least one synchronization memory coupled to at least one of at least one single-level direct subband transformer, for receiving and substantially synchronizing transformation coefficients with said fast encoder to produce synchronized transformed coefficients;

at least one processing means selected from a group **consisting of**: pass-through means for lossless processing and quantizer means for lossy processing, coupled to at least one of said at least one synchronization memory, for receiving and processing the synchronized transformation coefficients to produce synchronized processed transformation coefficients;

at least one encoding probability estimator coupled to at least one of said at least one processing means, for receiving the synchronized processed transformation coefficients and estimating probabilities of symbols within contexts of transformation coefficients to produce the probabilities of symbols within the contexts of transformation coefficients;

at least one entropy encoder coupled to at least one of said at least one encoding probability estimator, for receiving and entropy encoding the synchronized processed transformation coefficients using the probabilities of symbols within the contexts of transformation coefficients to produce encoded data; and

an output compressed buffer coupled to at least one of said at least one entropy encoder, for receiving and buffering the encoded data to produce output compressed data.

The comparison of the aforementioned amended claim 1, appropriate to Figures 13 and 15, and claim E, appropriate to the combination of Boliek Figure 2 and Ogata Figures 2, 4 and 6, clearly demonstrate that the claimed invention synchronizes already encoded (compressed) data in the output compressed buffer, thus requiring very little synchronization memory, while Boliek and Ogata synchronize (uncompressed) transformation coefficients, thus requiring huge synchronization memory.

In amended encoding claims 3 (apparatus), 115 (method) and 227 (article), THE CLAIMED INVENTION discloses the new lossless and lossy encoder, appropriate to the specification Figures 9 and 11, by additionally utilizing the synchronization memory BETWEEN the entropy encoder and the output compressed buffer, and not between the single-level direct subband transformer and

the quantizer, as used in Ogata Figures 2, 4 and 6. It is obvious that the position of the synchronization (delay) memory in Ogata is different from the position of the synchronization memory disclosed in the specification (numerals 320-321 in the specification Figure 9 and numerals 420-425 in the specification Figure 11), being between entropy encoders (numerals 180-181 in the specification Figure 9 and numerals 280-285 in the specification Figure 11) and the output compressed buffer (numeral 32 in both Figures 9 and 11).

The amended apparatus claim 3 for both lossless and lossy compression, appropriate to the specification Figures 9 and 11, with underlined differences between the specification and Boliek and Ogata is:

3. The fast encoder of claim 1, further comprising:

at least one single-level direct subband transformer for receiving and transforming input data to produce transformation coefficients;

at least one processing means selected from a group **consisting of**: pass-through means for lossless processing and quantizer means for lossy processing, coupled to at least one of said at least one single-level direct subband transformer, for receiving and processing the transformation coefficients to produce processed transformation coefficients;

at least one encoding probability estimator coupled to at least one of said at least one processing means, for receiving the processed transformation coefficients and estimating probabilities of symbols within contexts of transformation coefficients to produce the probabilities of symbols within the contexts of transformation coefficients;

at least one entropy encoder coupled to at least one of said at least one encoding probability estimator, for receiving and entropy encoding the processed transformation coefficients using the probabilities of symbols within the contexts of transformation coefficients to produce encoded data;

<u>at least one synchronization memory coupled to at least one of said at least one entropy encoder, for receiving and substantially synchronizing the encoded data with said fast encoder to produce synchronized compressed data; and</u>

an output compressed buffer coupled to at least one of said at least one <u>synchronization memory</u>, for receiving and buffering <u>synchronized compressed data</u> to produce the output compressed data.

For example, the prior art apparatus claim **E** for both lossless and lossy compression, appropriate to the combination of Boliek Figure 2 and Ogata Figures 2, 4 and 6, with underlined differences between the claimed invention and Boliek and Ogata

is:

E. An encoder for compressing input data into output compressed data, comprising:

at least one single-level direct subband transformer, for receiving and transforming input data to produce transformation coefficients;

at least one synchronization memory coupled to at least one of at least one single-level direct subband transformer, for receiving and substantially synchronizing transformation coefficients with said fast encoder to produce synchronized transformed coefficients;

at least one processing means selected from a group **consisting of**: pass-through means for lossless processing and quantizer means for lossy processing, coupled to at least one of said at least one synchronization memory, for receiving and processing the synchronized transformation coefficients to produce synchronized processed transformation coefficients;

at least one encoding probability estimator coupled to at least one of said at least one processing means, for receiving the synchronized processed transformation coefficients and estimating probabilities of symbols within contexts of transformation coefficients to produce the probabilities of symbols within the contexts of transformation coefficients;

at least one entropy encoder coupled to at least one of said at least one encoding probability estimator, for receiving and entropy encoding the synchronized processed transformation coefficients using the probabilities of symbols within the contexts of transformation coefficients to produce encoded data; and

an output compressed buffer coupled to at least one of said at least one entropy encoder, for receiving and buffering the encoded data to produce output compressed data.

The comparison of the aforementioned amended claim 3, appropriate to the specification Figures 9 and 11, and claim E, appropriate to the combination of Boliek Figure 2 and Ogata Figures 2, 4 and 6, clearly demonstrate that the claimed invention synchronize already encoded (compressed) data before output compressed buffer, thus requiring very little synchronization memory, while Boliek & Ogata synchronize (uncompressed) transformation coefficients, thus requiring huge synchronization memory.

Therefore, any combination of Boliek and Ogata made by ordinary skilled in the art, i.e. including the codec system Boliek made with the time delay buffer as taught by Ogata, will provide the resulting encoder in the form of prior art encoders shown in Ogata Figures 2, 4 and 6, or the equivalent the

specification Figures 5 and 7, and not in the form of new encoders disclosed in the specification Figures 9, 11, 13 and 15, which decrease total memory capacity for several orders of magnitude in comparison with prior art encoders, due to storage of compressed data instead of uncompressed transformation coefficients in the memory, and as a positive side-effect significantly increase encoding speed, according to the specification pages 48-50.

The similar reasoning applies to decoding claims 56-68 (apparatus), 168-180 (method) and 280-292 (article).

Ogata Figure 3 depicts art prior to Ogata, while Ogata Figures 5 and 7 show art disclosed in Ogata, according to Ogata column 5, lines 23-29. However, in either one of Ogata Figures 3, 5 or 7, the position of synchronization (delay) memory (numeral 136 in Ogata Figure 3, numeral 26 in Ogata Figure 5 and numerals 73a, 73b, 73c in Ogata Figure 7) is the same, being between dequantizer (numeral 132c in Ogata Figure 3, numeral 22c in Ogata Figure 5 and numerals 62e, 62f, 62g in Ogata Figure 7) and upsampling unit (numeral 137_H in Ogata Figure 3 and numeral 27_H in Ogata Figure 5) or memory (numerals 74_H, 75_L and 75_H in Ogata Figure 7), as well as EXACTLY THE SAME to the position of synchronization memory in well-known prior-art decoder designs (numerals 130-132 in the specification Figure 6, numerals 230-238 in amended Figure 8, with correct numerals 230, 231 and 232

instead of 220, 221 and 222, respectively), being between dequantizers (numerals 150-151 in the specification Figure 6, and numerals 250-255 in the specification Figure 8) and single-level inverse subband transformers (numerals 110-111 in the specification Figure 6, and numerals 210-211 in the specification Figure 8).

In amended decoding claims 56 (apparatus), 168 (method) and 280 (article), the specification discloses the new lossless and lossy decoder, appropriate to the specification Figures 14 and 16, by utilizing either state-of-the-art or new (disclosed later in the other claims) elements, such as: a single-level inverse subband transformer, processing means (pass-through means as in claim 56 as filed or dequantizer means as in claim 57 as filed), a decoding probability estimator, an entropy decoder, and an input compressed buffer, connected BEFORE the entropy decoder, without any additional synchronization (delay) memory used in Ogata Figures 3, 5 and 7, being between the dequantizer and the single-level inverse subband transformer.

The amended apparatus claim 56 for both lossless and lossy compression, appropriate to the specification Figures 14 and 16, with underlined differences between the claimed invention and Boliek and Ogata is:

56. A fast decoder for decompressing input compressed data into

output data, comprising:

an input compressed buffer, for receiving and <u>substantially synchronizing</u> input compressed data with said fast decoder to produce <u>synchronized</u> compressed data;

at least one entropy decoder coupled to said input compressed buffer, for receiving and decoding the <u>synchronized</u> compressed data using probabilities of symbols within contexts of transformation coefficients to produce transformation coefficients;

at least one decoding probability estimator coupled to at least one of said at least one entropy decoder, for receiving the transformation coefficients and estimating the probabilities of symbols within contexts of transformation coefficients to produce the probabilities of symbols within the contexts of transformation coefficients;

at least one processing means, selected from a group **consisting of**: pass-through means for lossless processing and dequantizer means for lossy processing, coupled to at least one of said at least one entropy decoder, for receiving and processing the transformation coefficients to produce processed transformation coefficients; and

at least one single-level inverse subband transformer coupled to at least one of said at least one processing means, for receiving and transforming the processed transformation

coefficients to produce output data.

For example, the prior art apparatus claim **D** for both lossless and lossy compression, appropriate to the combination of Boliek Figure 2 and Ogata Figures 3, 5 and 7, with underlined differences between the claimed invention and Boliek and Ogata is:

D. A decoder for decompressing input compressed data into output data, comprising:

an input compressed buffer, for receiving and <u>buffering</u> input compressed data to produce buffered compressed data;

at least one entropy decoder coupled to said input compressed buffer, for receiving and decoding the buffered compressed data using probabilities of symbols within contexts of transformation coefficients to produce transformation coefficients;

at least one decoding probability estimator coupled to at least one of said at least one entropy decoder, for receiving the transformation coefficients and estimating the probabilities of symbols within the contexts of transformation coefficients to produce the probabilities of symbols within the contexts of transformation coefficients;

at least one processing means, selected from a group

consisting of: pass-through means for lossless processing and dequantizer means for lossy processing, coupled to at least one of said at least one entropy decoder, for receiving and processing the transformation coefficients to produce processed transformation coefficients;

at least one synchronization memory coupled to at least one of at least one processing means, for receiving and substantially synchronizing processed transformation coefficients with said fast decoder to produce synchronized processed transformed coefficients; and

at least one single-level inverse subband transformer coupled to at least one of said at least one synchronization memory, for receiving and transforming the synchronized processed transformation coefficients to produce output data.

The comparison of the aforementioned amended claim 56, appropriate to the specification Figures 14 and 16, and claim D, appropriate to the combination of Boliek Figure 2 and Ogata Figures 3, 5 and 7, clearly demonstrate that the claimed invention synchronize already compressed data in the input compressed buffer, thus requiring very little synchronization memory, while Boliek and Ogata synchronize (decompressed) transformation coefficients, thus requiring huge synchronization memory.

In amended decoding claims 58 (apparatus), 170 (method) and 282 (article), the specification discloses the new lossless and lossy decoder, appropriate to the specification Figures 10 and 12, by additionally utilizing the synchronization memory BETWEEN the input compressed buffer and the entropy decoder, and not between the dequantizer and the single-level inverse subband transformer, as used in Ogata Figures 3, 5 and 7. It is obvious that the position of the synchronization (delay) memory in Ogata is different from the position of the synchronization memory disclosed in the specification (numerals 330-331 in the specification Figure 10 and numerals 430-435 in the specification Figure 12), being between input compressed buffer (numeral 33 in both Figures 10 and 12) and entropy decoders (numerals 190-191 in the specification Figure 10 and numerals 290-295 in the specification Figure 12).

The amended apparatus claim 58 for both lossless and lossy decompression, appropriate to the specification Figures 10 and 12, with underlined differences between the claimed invention and Boliek and Ogata is:

58. The fast decoder of claim 56, further comprising:

an input compressed buffer, for receiving and buffering input compressed data to produce buffered compressed data;

<u>at least one synchronization memory coupled to said input</u>

compressed buffer, for receiving and substantially synchronizing buffered compressed data with said fast decoder to produce synchronized compressed data;

at least one entropy decoder coupled to at least one of said at least one synchronization memory, for receiving and decoding the synchronized compressed data using probabilities of symbols within contexts of transformation coefficients to produce transformation coefficients;

at least one decoding probability estimator coupled to at least one of said at least one entropy decoder, for receiving the transformation coefficients and estimating the probabilities of symbols within contexts of transformation coefficients to produce the probabilities of symbols within the contexts of transformation coefficients;

at least one processing means, selected from a group consisting of: pass-through means for lossless compression and dequantizer means for lossy compression, coupled to at least one of said at least one entropy decoder, for receiving and processing the transformation coefficients to produce processed transformation coefficients; and

at least one single-level inverse subband transformer coupled to at least one of said at least one processing means, for receiving and transforming the processed transformation coefficients to produce output data.

For example, the prior art apparatus claim D for both lossless and lossy decompression, appropriate to the combination of Boliek Figure 2 and Ogata Figures 3, 5 and 7, with underlined differences between the claimed invention and Boliek and Ogata is:

D. A decoder for decompressing input compressed data into output data, comprising:

an input compressed buffer, for receiving and buffering input compressed data to produce buffered compressed data;

at least one entropy decoder coupled to said <u>input compressed buffer</u>, for receiving and decoding the <u>buffered</u> compressed data using probabilities of symbols within contexts of transformation coefficients to produce transformation coefficients;

at least one decoding probability estimator coupled to at least one of said at least one entropy decoder, for receiving the transformation coefficients and estimating the probabilities of symbols within the contexts of transformation coefficients to produce the probabilities of symbols within the contexts of transformation coefficients;

at least one processing means, selected from a group consisting of: pass-through means for lossless processing and

dequantizer means for lossy processing, coupled to at least one of said at least one entropy decoder, for receiving and processing the transformation coefficients to produce processed transformation coefficients;

at least one synchronization memory coupled to at least one of at least one processing means, for receiving and substantially synchronizing processed transformation coefficients with said fast decoder to produce synchronized processed transformed coefficients; and

at least one single-level inverse subband transformer coupled to at least one of said at least one synchronization memory, for receiving and transforming the synchronized processed transformation coefficients to produce output data.

The comparison of the aforementioned amended claim 58, appropriate to the specification Figures 10 and 12, and claim D, appropriate to the combination of Boliek Figure 2 and Ogata Figures 3, 5 and 7, clearly demonstrate that the specification synchronize already encoded (compressed) data after input compressed buffer, thus requiring very little synchronization memory, while Boliek & Ogata synchronize (decompressed) transformation coefficients, thus requiring huge synchronization memory.

Therefore, any combination of Boliek and Ogata made by

ordinary skilled in the art, i.e. including the codec system Boliek made with the time delay buffer as taught by Ogata, will provide the resulted decoder in the form of prior art decoders shown in Ogata Figures 3, 5 and 7, or the equivalent specification Figures 6 and 8, and not in the form of new decoders disclosed in the specification Figures 10, 12, 14 and 16, which decrease total memory capacity for several orders of magnitude in comparison with prior art decoders, due to storage of compressed data instead of decompressed transformation coefficients in the memory, and as a positive side-effect significantly increase decoding speed, according to the specification pages 48-50.

In view of the foregoing, Applicants respectfully submit that claims 1 and 56 should be allowable over Boliek and Ogata.

Regarding claims 2-13, 31-34, 57-68, and 86-89, these claims are dependent upon independent claims 1 and 56. If an independent claim is nonobvious under *35 USC § 103*, then any claim depending therefrom is nonobvious. In re Fine, 837 F. 2d 1071 (Fed. Cir. 1988). Thus, since independent claims 1 and 56 should be allowable as discussed above, claims 2-13, 31-34, 57-68, and 86-89 should also be allowable at least by virtue of their dependency on independent claims 1 and 56. Moreover, most of these claims recite additional features which are not disclosed, or even suggested, by the cited references taken

either alone or in combination, according to the further arguments.

Regarding claims 113, 168, 225, and 280, while different in overall scope, these claims recite subject matter related to claims 1 and 56. Thus, the arguments set forth above with respect to claims 1 and 56 are equally applicable to claims 113, 168, 225, and 280. Accordingly, Applicants respectfully submit that claims 113, 168, 225, and 280 should be allowable over Boliek and Ogata for the same reasons as set forth above with respect to claims 1 and 56.

Regarding claims 114-125, 143-146, 169-180, 198-201, 226-237, 255-258, 281-292, and 310-313, these claims are dependent upon independent claims 113, 168, 225, and 280. If an independent claim is nonobvious under *35 USC § 103*, then any claim depending therefrom is nonobvious. In re Fine, 837 F. 2d 1071 (Fed. Cir. 1988). Thus, since independent claims 113, 168, 225, and 280 should be allowable as discussed above, claims 114-125, 143-146, 169-180, 198-201, 226-237, 255-258, 281-292, and 310-313 should also be allowable at least by virtue of their dependency on independent claims 113, 168, 225, and 280. Moreover, most of these claims recite additional features which are not disclosed, or even suggested, by the cited references taken either alone or in combination.

In view of the foregoing, Applicants respectfully request

that the aforementioned obviousness rejection of claims 1-13, 31-34, 56-68, 86-89, 113-125, 143-146, 168-180, 198-201, 225-237, 255-258, 280-292, 310-313, 337-349, 449, and 450 be withdrawn.

Regarding encoding claims 10, 122, and 234 (direct non-stationary filter), decoding claims 65, 177, and 289 (inverse non-stationary filter), encoding claims 12, 124, and 236 (direct non-stationary filter), decoding claims 67, 179, and 291 (inverse non-stationary filter), encoding claims 13, 125, and 237 (direct non-stationary filter cells) and decoding claims 68, 180, and 292 (inverse non-stationary filter cells), Applicants respectfully disagree that "the adaptive filtering teaches the concept of non-stationary filter or serially coupled non-stationary filter".

Applicants would like to draw the attention of the Examiner that adaptive filtering mentioned in Boliek column 40, line 23 ("...5-tap low pass filter...") is different from non-stationary filtering, which utilizes the different structure of the filter. For example, non-stationary filter in one cycle can be 5-tap low pass filter with static filter coefficients and in another cycle can be 3-tap low pass filter with static filter coefficients, while the adaptive filter will be always 5-tap low pass filter with variable filter coefficients.

The definition of an adaptive filter at

http://en.wikipedia.org/wiki/Adaptive_filter is:

"An adaptive filter is a filter that self-adjusts its transfer function according to an optimizing algorithm. Because of the complexity of the optimizing algorithms, most adaptive filters are digital filters that perform digital signal processing and adapt their performance based on the input signal. By way of contrast, a non-adaptive filter has static filter coefficients (which collectively form the transfer function)".

A transfer function of a non-stationary filter according to the specification is not self-adjusted by any optimizing algorithm, nor there is any optimizing algorithm. Also, the input signal does not have any influence to a transfer function, which preferably results from a predetermined time-varying (non-stationary) structure of the non-adaptable filter with static filter coefficients, described in detail in the specification between page 18, line 4 and page 26, line 18.

At the bottom of page 6 of *http://sep.stanford.edu/data/media/public/docs/sep108/james1.pdf* : "A non-stationary filter can have a different impulse response for each point in the input/output space."

Furthermore, a mixed class of non-stationary adaptive filters was introduced in page 1 of:

http://reproducibility.org/RSF/book/jsg/lpf/paper.pdf

Finally, in the most comprehensive 990-page book related to adaptive filters, written by Symon Haykin: "Adaptive Filter Theory", Prentice Hall, Upper Saddle River, NJ 07458, 2001, there is no mentioning of non-stationary filters, which you can witness by reading the whole book or just selecting the index on Internet and finding letter N at:

http://www.amazon.com/Adaptive-Filter-Theory-Simon-Haykin/dp/0130901261/ref=reader_auth_dp#reader_0130901261

Regarding encoding claims 32, 144, and 256 (low-pass histogram filtering) and decoding claims 87, 199, and 311 (low-pass histogram filtering), Applicants would like to draw the attention of the Examiner that the definition of LPS (Least Probable Symbol) as "The outcome in a binary decision with less than 50% probability." in Boliek column 7 <u>is not related</u> to low-pass filtering of probabilities or any other signal, according to pages 496-497 of Richard G. Lyons, "Understanding Digital Signal Processing", Prentice Hall, Upper Saddle River, NJ 07458, 2001. The specification treats probability values as signal samples in order to smooth the variation of probability using first-order low-pass infinite impulse response (IIR) filter

according to equations given in the specification page 38, lines 5-6, which are described in detail in the specification page 36, line 4 to page 38, line 25, with experimental results in the specification Figures 37A-37E and the specification page 38, line 26 to page 39, line 3. Therefore, the specification teaches the frequency-domain concept of outputting low-pass filtered (smoothed) probability having value between 0 (0%) and 1 (100%), while according to the Examiner, Boliek teaches the time-domain concept of outputting probability of less probable symbol, having value less than 50%, which has nothing common with frequency-domain low-pass filtering concept in the specification.

Regarding encoding claims 33, 145, and 257 (dominant pole adapter) and decoding claims 88, 200, and 312 (dominant pole adapter), Applicants would like to draw the attention of the Examiner that the definition of MPS (Most Probable Symbol) as "The outcome in a binary decision with more than 50% probability." in Boliek column 7 is not related to the adaptation of a dominant pole or cut-off frequency defined in pages 496-497 of Richard G. Lyons, "Understanding Digital Signal Processing", Prentice Hall, Upper Saddle River, NJ 07458, 2001, as: "A cutoff frequency is determined by the -3dB point of a filter magnitude response relative to a peak passband value. Figure F-3 illustrates the f_c cutoff frequency of a low-pass

filter." and page 147 of A. Pittet, A. Kandaswamy "Analog Electronics", Prentice-Hall of India, New Delhi-110001, 2005, showing the relationship between a cutoff frequency and a dominant pole in case of low-pass filters, available at:

http://books.google.com/books?id=TjFkX93jyRAC&pg=PA147&lpg=PA147&dq=cutoff-frequency+analog-electronics+%22dominant+pole+%22&source=bl&ots=f5r5DhU0P3&sig=XORmLAT56sl6mLtS6doRKSdCW5g&hl=en&ei=Q9NES-rfB9CK4QbptJCqCA&sa=X&oi=book_result&ct=result&resnum=1&ved=0CAgQ6AEwAA#v=onepage&q=&f=false

The specification treats probability values as signal samples in order to smooth the variations of probability using first-order low-pass infinite impulse response (IIR) filter according to equations given in the specification page 38, lines 5-6, which are described in detail in the specification page 36, line 4 to page 38, line 25, with experimental results in the specification Figures 37A-37E and the specification page 38, line 26 to page 39, line 3. <u>Therefore, the specification teaches the frequency-domain concept of outputting low-pass filtered (smoothed) probability having value between 0 (0%) and 1 (100%) controlling the maximum passband (non-attenuated) frequency of</u>

the variation of probability by adapting a value of the dominant pole (higher the dominant pole, higher the maximum passband (non-attenuated) frequency of the variation of probability), while according to the Examiner, Boliek teaches the time-domain concept of outputting probability of more probable symbol, having value greater than 50%, which has nothing common with frequency-domain dominant pole adapter in the specification.

Regarding encoding claims 34, 146, and 258 (dominant pole divider) and decoding claims 89, 201, and 313 (dominant pole divider), the "50% probability" in Boliek column 7 is not related to the halving of a value of the dominant pole or cut-off frequency defined in pages 496-497 of Richard G. Lyons, "Understanding Digital Signal Processing", Prentice Hall, Upper Saddle River, NJ 07458, 2001, as: "A cutoff frequency is determined by the -3dB point of a filter magnitude response relative to a peak passband value. Figure F-3 illustrates the f_c cutoff frequency of a low-pass filter." and page 147 of A. Pittet, A. Kandaswamy "Analog Electronics", Prentice-Hall of India, New Delhi-110001, 2005, showing the relationship between a cutoff frequency and a dominant pole in case of low-pass filters, available at:

http://books.google.com/books?id=TjFkX93jyRAC&pg=PA147&lpg=PA147 &dq=cutoff-frequency+analog-

electronics+%22dominant+pole+%22&source=bl&ots=f5r5DhU0P3&sig=XORmLAT56sl6mLtS6doRKSdCW5g&hl=en&ei=Q9NES-rfB9CK4QbptJCqCA&sa=X&oi=book_result&ct=result&resnum=1&ved=0CAgQ6AEwAA#v=onepage&q=&f=false

The specification treats probability values as signal samples in order to smooth the variations of probability using first-order low-pass infinite impulse response (IIR) filter according to equations given in the specification page 38, lines 5-6, which are described in detail in the specification page 36, line 4 to page 38, line 25, with experimental results in the specification Figures 37A-37E and the specification page 38, line 26 to page 39, line 3. <u>Therefore, the specification teaches the frequency-domain concept of outputting low-pass filtered (smoothed) probability having value between 0 (0%) and 1 (100%) controlling the maximum passband (non-attenuated) frequency of the variation of probability by halving a value of the dominant pole (which is halving the maximum passband (non-attenuated) frequency of the variation of probability), while according to the Examiner, Boliek teaches the time-domain concept of outputting probability of either less or more probable symbol, having value either less than 50% or greater than 50%, which has nothing common with frequency-domain halving of a value of the</u>

dominant pole in the specification.

V. THE OBVIOUSNESS REJECTION OF CLAIMS 40-41, 95-96, 152-153, 207-208, 264-265, AND 319-320

On pages 17-19 of the Office Action, claims 40-41, 95-96, 152-153, 207-208, 264-265, and 319-320 were rejected under 35 USC § 103(a) as being unpatentable over the combination of U.S. Patent No. 6,141,446 issued to Boliek et al. ("Boliek") and U.S. Patent No. 5,926,791 issued to Ogata et al. ("Ogata") as applied to claims 1, 56, 113, 168, 225, and 280, and further in view of D. J. Magenheimer et al., "Integer multiplication and division on the HP precision architecture," *IEEE Trans. Computers*, Vol. 37, No. 8, p. 980-990, Aug. 1988. ("Magenheimer"), which was referenced in the specification page 45, lines 24-26 reference the IDS cite no. 22. This rejection is hereby respectfully traversed.

Regarding claims 40-41, 95-96, 152-153, 207-208, 264-265, and 319-320, applied to claims 1, 56, 113, 168, 225, and 280, the Examiner asserts that the claimed invention would have been obvious in view of Boliek and Ogata, and further in view of Magenheimer. Applicants respectfully disagree. Specifically, Applicants would like to draw the attention of the Examiner that they didn't claim the range encoder (OLD CODER) shown in the specification page 39, lines 4-9 and the specification Figure

39, but the range encoder of this invention disclosed in the specification page 44, lines 13 to page 45, line 5 and the specification Figures 41A and 41B, and they didn't claim the range decoder (OLD CODER) shown in the specification page 42, lines 8 to page 44, line 12, but the range decoder of this invention disclosed in the specification page 45, lines 6 to 30 and Figure 42.

The Examiner correctly concluded that regarding claims 40, 152, and 264, the combination of Boliek and Ogata neither disclose the range encoder as entropy encoder, nor disclose divider for a range encoder.

However, the Examiner incorrectly concluded that one ordinary skilled in the art would have been motivated to combine Boliek and Ogata with Magenheimer in order to have a fast processing.

The claimed invention has several improvements listed over OLD CODER, which are not a result of Boliek, Ogata and Magenheimer. These improvements result from the adaptive histogram updating means, providing a number *Total* of occurrences of all symbols to be the power of two ($Total = 2^{w_3}$), instead being an arbitrary integer in OLD CODER, as emphasized in the specification page 36, lines 14-16 and page 44, lines 13-17, which prevented efficient utilization of OLD CODER in digital processing systems, due to requirements for division

operations, shown in the specification page 46, TABLES 18 and 19.

Therefore, there is no need to use any of results disclosed in Magenheimer et al. in order to provide division with *Total* or shifting right for $w_3 = \log_2(Total)$ bit positions, instead of division by $Total = 2^{w_3}$, which results from adaptive histogram updating means.

Actually, Magenheimer work was just referenced as an example in the specification page 45, lines 23-28, how to perform the division by constant small odd numbers in another less efficient manner, requiring 17 instructions for division (Magenheimer page 988, first column, last two sentences), which is not claimed at all in the present application. It is also obvious that numbers shown in the specification TABLE 17 differ from numbers shown in Magenheimer Figure 7 on page 988, due to different mathematics used.

VII. CONCLUSION

In view of the foregoing, Applicant respectfully submits that the present application is in condition for allowance, and an early indication of the same is courteously solicited. The Examiner is respectfully requested to contact the undersigned by telephone at the below listed telephone number, in order to

expedite resolution of any issues and to expedite passage of the present application to issue, if any comments, questions, or suggestions arise in connection with the present application.

To the extent necessary, a petition for an extension of time under 37 CFR § 1.136 is hereby made.

Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account No. 50-0206, and please credit any excess fees to the same deposit account.

Respectfully submitted,

Hunton & Williams LLP

By: ______________________
Thomas E. Anderson
Registration No. 37,063

TEA/vrp

Hunton & Williams LLP
1900 K Street, N.W.
Washington, D.C. 20006-1109
Telephone: (202) 955-1500
Facsimile: (202) 778-2201

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APPENDIX A